U.S. DEPARTMENT OF ENERGY

Environmental Management Science and Technology Update

Site-Specific Advisory Board Chairs Meeting

Idaho Falls, Idaho *September 23, 2009*

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Deputy Assistant Secretary for Engineering & Technology

EM Mission

"Complete the safe cleanup of the environmental legacy brought about from five decades of nuclear weapons development, production, and Government-sponsored nuclear energy research."






- *Largest environmental cleanup effort in the world, originally involving two million acres at 108 sites in 35 states*
- *Safely performing work*
  - *In challenging environments*
  - *Involving some of the most dangerous materials known to man*
  - *Solving highly complex technical problems with first-of-a-kind technologies*
- *Operating in the world's most complex regulatory environment*
- *Supporting other continuing DOE missions and stakeholder partnerships*

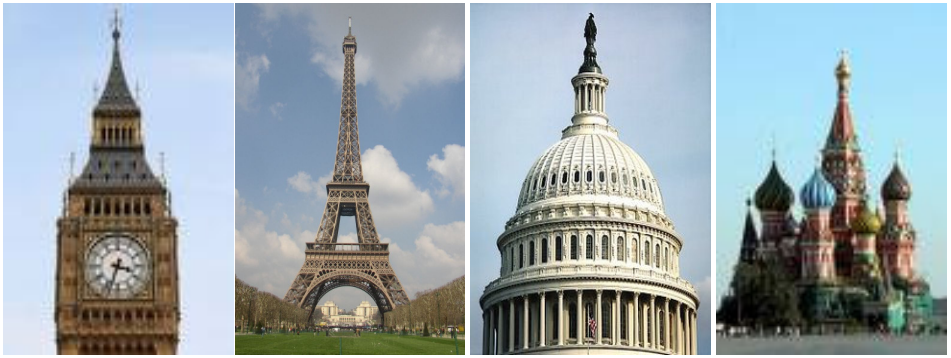
20 Years of Progress – Summary

- **The Department's Responsibility**
  - **Cleanup of radioactive waste and contamination generated by nuclear energy research and weapons production**
  - **Protection of groundwater and soil**
  - **Reduction of risk to the Nation's citizens**

- **2009 Marks 20 Years of Our Cleanup Effort**
  - **Demonstrated progress in cleanup**
  - **Technological breakthroughs**

- **Our Future**
  - **Continuing nuclear waste challenges to be solved**
  - **Implications for the world's energy future**

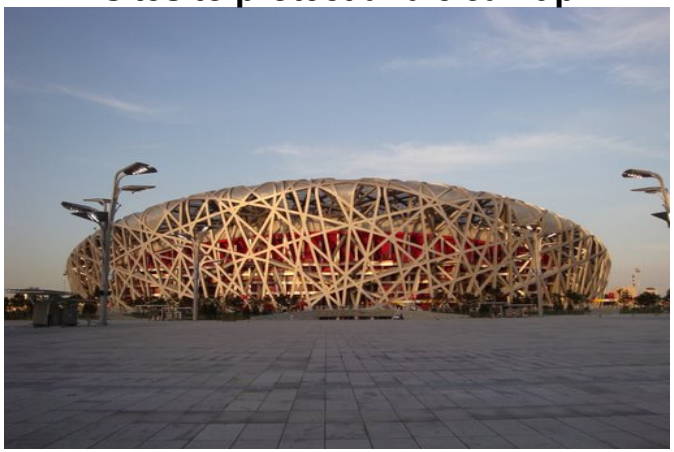
Five Decades of Nuclear Research and Weapons Production – The Legacy



Sites covering 8,100 sq. km., nearly the size of London, Paris, Washington, and Moscow *combined*

4,500 facilities to decontaminate and demolish

More than 10,000 groundwater and soil sites to protect and clean up

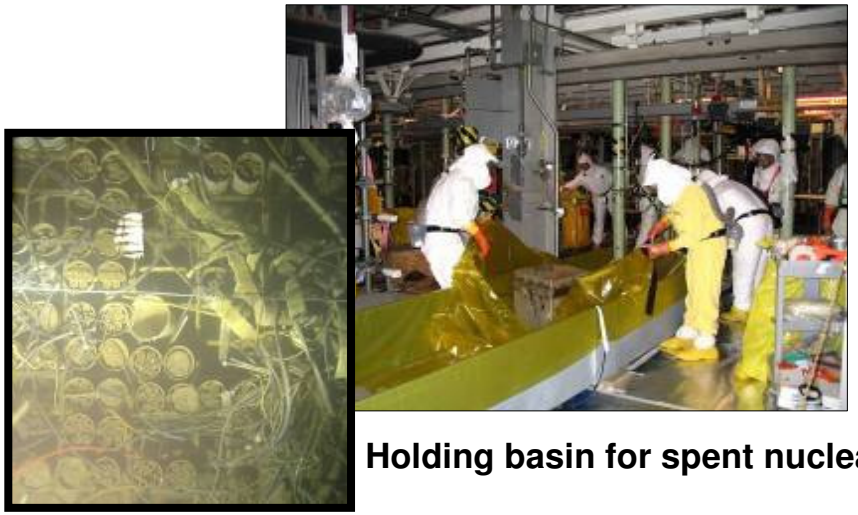


Enough nuclear waste to fill the Beijing National Olympic Stadium

The Inherently High-Risk Work of Nuclear Cleanup

We work with some of the most dangerous substances known to humanity…

Workers using glovebox to handle plutonium



Holding basin for spent nuclear fuel

Performing first-of-a-kind tasks in highly hazardous work environments

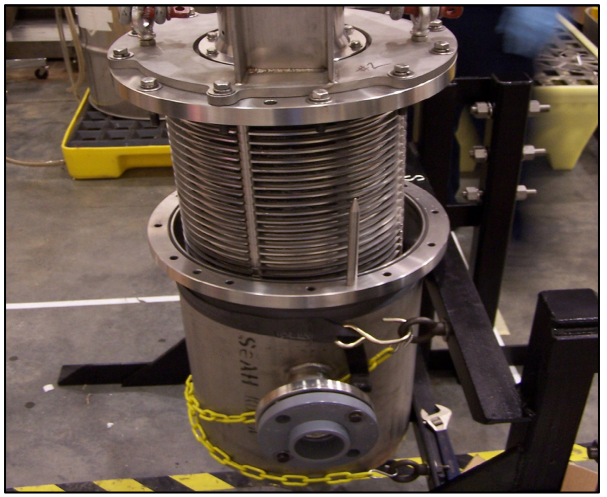
Working with high-level waste

We Solve Problems That Once Seemed Unsolvable

The Department's work has led to the design, construction and operation of first-of-a-kind facilities and technologies.

Hanford, Washington Liquid Waste Treatment Plant = US$12 Billion

Device for removing sludge from bottom of liquid waste storage tank



Microfilter for separating solids and liquids developed at Savannah River National Laboratory

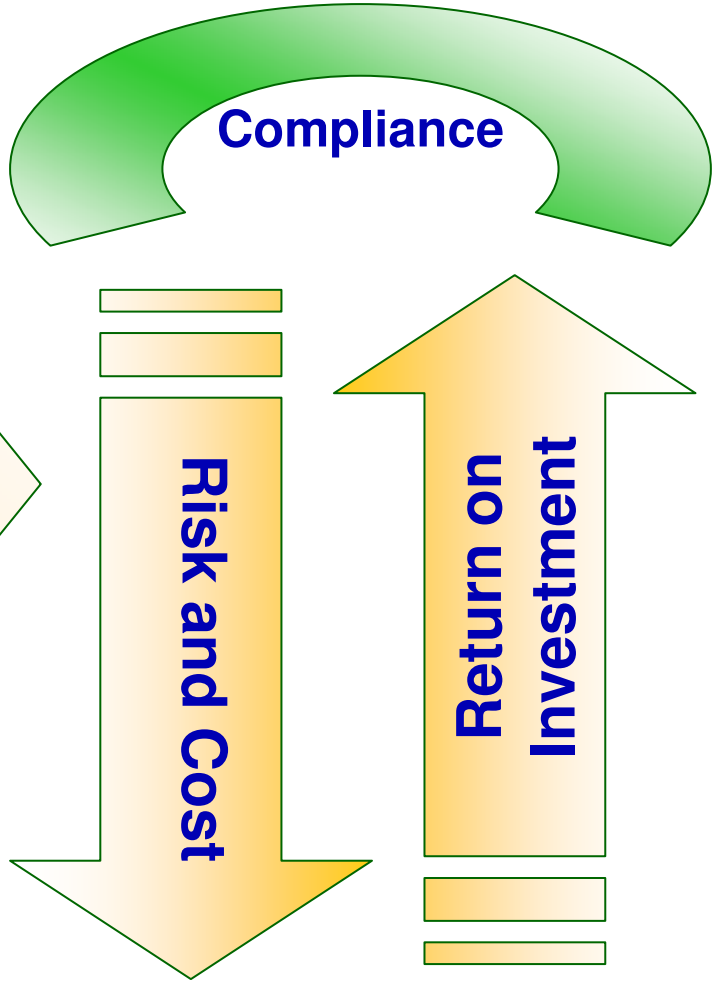
Cleanup Approach

Sound business practices
- Near term completions
- Footprint reduction

Use science and technology to optimize the efficiency of tank waste disposition

Use science and technology to optimize the efficiency of excess nuclear materials, and spent nuclear fuel disposition

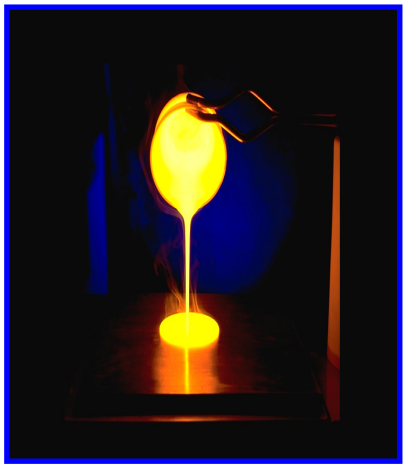
Alternative management approaches such as the Energy Parks Initiative



New Technologies and Processes Benefit EM Cleanup Mission

New decontamination approach at Rocky Flats significantly minimized waste generation and ultimately enabled site closure

Robotic crawler reduced worker safety risk at Hanford site



Improved glass formulation saved millions of dollars at Savannah River's Defense Waste Processing Facility

Alternatives to costly Pump and Treat technology used to clean up contaminated soil and groundwater

New technology deployment resulted in significant risk reduction and cost avoidance.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

National Research Council of the National Academies of Sciences' (NAS) Report (February 2009): Advice on DOE's Cleanup Technology Roadmap, Gaps and Bridges

- The complexity and enormity of EM's cleanup task require the results from a significant, ongoing R&D program so that EM can complete its cleanup mission safely, cost effectively, and expeditiously.
- EM Roadmap can be an important tool for guiding R&D investments.
- National Laboratories at each of the four major sites have special capabilities that are needed to address EM's long-term needs.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Technology Development and Deployment Strategic Initiatives laid out in the Environmental Management Engineering and Technology Roadmap (March 2008)

- **Waste Processing**
  - Improved Waste Storage
  - Reliable and Efficient Waste Retrieval
  - Enhance Tank Closure Processes
  - Next-Generation Pretreatment Solutions
  - Enhanced Stabilization
  - Spent Nuclear Fuel: Improved Storage, Stabilization and Disposal preparation
  - Challenging Materials: Enhanced Storage, Monitoring and Stabilization Systems
- **Groundwater and Soil**
  - Improved Sampling and Characterization Strategies
  - Advanced Predictive Capabilities
  - Enhanced Remediation Methods
- **Deactivation and Decommissioning (D&D)**
  - Characterization
  - Deactivation, Decontamination, and Demolition
  - Closure

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Strategic Planning Approach for Engineering and Technology Program Activities

- Implementation of Roadmap Initiatives
- Critical, High-Risk, High-Payoff Projects that address needs identified by Federal Project Directors
- Critical investments to reduce technical uncertainty associated with tank waste and groundwater at the Hanford site
- Technical Workshops and Exchanges to share information and lessons learned
- External Technical Reviews and Site Risk Management Plans to determine project specific technical gaps and uncertainties
- Technology Readiness Assessments to focus investments in technologies to support first-of-a kind applications to improve technical maturity
- Coordination across Complex via Corporate Boards
- Peer reviews and/or project reviews for new and ongoing projects prior to selection and at key points in the project development

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Leverage Research Investments

- Leverage investments made within the Department by Office of Science, Office of Nuclear Energy, National Nuclear Security Administration, and Office of Civilian Radioactive Waste Management, especially in the areas of predicting high level waste performance and characterization of radiological waste.

- Leverage investments made by other federal agencies such as Department of Defense (e.g., Strategic Environmental Research and Development Program), Department of Homeland Security (e.g., radiation detection) and National Institute of Standards and Technology.

- Continue to work cooperatively with Nuclear Regulatory Commission and Environmental Protection Agency on issues such as long term performance of cementitious materials.

- Continue to work cooperatively with the United Kingdom Nuclear Decommissioning Authority to share lessons learned for cleanup activities and to conduct joint Technology Readiness Assessments to evaluate technologies being developed and implemented in the United Kingdom.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Applied Research and Technology Development at Office of River Protection

- In-tank/Near Tank Pretreatment: Development of technology to remove non-radioactive components of high level waste tank sludge to reduce the amount of waste to be treated as high level waste (HLW). This has the potential of dramatically reducing the number of canisters of HLW.

- Tank Waste Chemistry: Development of fundamental, "world class" materials aging technologies for characterization and modeling to verify waste tank structural integrity as material properties change with waste tank age. This is needed to ensure safe tank operations.

- Advanced Retrieval Technologies: Development of technologies to retrieve non-homogeneous waste with variable viscosities and other physical properties that will affect retrieval throughput.

- Next Generation Melters and Improved Glass Loading: Development of new generation melters to improve melter throughput and glass waste loading. Develop alternative glass formulation strategies to maximize next generation high-throughput melter.

- Computational Applied Research in Subsurface Science to Support Performance Assessments and Tank Closure: Development of state-of-the-art methods and models for fate and transport in the subsurface and vadose zone at Hanford. Reduce the uncertainty in the current models and methods used for performance assessments.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Waste Processing FY 2010 Planned Accomplishments

- Improve waste storage technologies at SRS by providing technologies to understand structural vulnerability and chemical corrosion mechanisms in waste tanks to preserve tank integrity and enable enhanced capacity and evaluating selected additives that can be mixed with waste slurries to improve the rheological properties in order to enable processing and increase solids loading.
- Provide efficient retrieval technology at SRS to remove the most difficult waste heels from waste tanks and other ancillary systems with emphasis on tanks with obstructions and demonstrate a suite of rapid characterization technologies to directly measure waste properties to provide critical data needed to select the most efficient and cost-effective removal technology.
- Develop improved formulations and methods for using grout or other materials to stabilize residual tank waste and ancillary systems (e.g., pump tanks, transfer lines, etc.) to assure that long-term performance objectives are met.
- Demonstrate fluidized bed steam reforming technology as an alternative supplemental treatment method.
- Develop low temperature treatment processes to immobilize volatile and semi-volatile radionuclides (e.g., cesium-137, technectium-99, and iodine-129).
- Improve glass formulation and demonstration of high aluminum containing glasses for Defense Waste Processing Facility.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Soils and Groundwater FY 2010 Planned Accomplishments

- Improve sampling and characterization by demonstrating geophysical tools at Oak Ridge to detect contamination under slabs and other buried infrastructure such as piping to support remediation of mercury contamination. Complete demonstration of a mercury soil stabilization method for remediation of soils at Oak Ridge to prevent mobilization of mercury in the subsurface.

- Develop advanced site conceptual model techniques that incorporate various characterization methods and provide a platform for use of advanced reactive transport models to enhance understanding of contaminant fate and transport to determine more effective remediation systems, e.g., evaluation and implementation of in-situ remediation methods, especially for soils in the Hanford 100 and 200 areas. Demonstrate delivery and access method for deep vadose zone contamination at Hanford to provide improved characterization tools for protection of the Columbia River watershed.

- Initiate development of predictive models that combine high performance computing with advanced physical and chemistry models that will integrate thermal, hydrological, mechanical, and chemical models for contaminant fate and transport in the subsurface, including the vadose zone to assist with design of effective and sustainable remediation strategies.

- Demonstrate enhanced attenuation technologies for metals and radionuclides stabilization and for solvent contamination at Savannah River Site to provide a lower cost, less invasive, and more effective remediation approach for metal and radioactive contamination in the subsurface. Develop in-situ bioreductive process to immobilize contaminant metals and radionuclides in the subsurface at SRS.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Deactivation and Decommissioning FY 2010 Planned Accomplishments

- Develop or improve robotic platforms that can be used in highly radioactive environments to characterize conditions and to remove infrastructure materials such as glove boxes, pipelines, and ventilation ducts.

- Develop improved or innovative D&D technologies to address issues in highly radioactive contaminated facilities, especially large structures, to reduce technical risk, improve safety, and limit uncertainty within D&D operations. Test and demonstrate in-situ decommissioning technology to determine effective achievement of required end state conditions (e.g., production reactors at SR).

- Demonstrate remote mapping, visualization, characterization, and/or monitoring technologies and fixative coatings and fogs for decontamination of buildings at Oak Ridge.

- Develop technology and approaches for characterization, containment/entombment, and continuous surveillance and monitoring; establish the scientific and technical basis for end state conditions.

Technology Development and Deployment: Reducing Technical Risk and Uncertainty

Recent Accomplishments

- Development of Low Temperature Caustic Process to separate aluminum from the aluminum rich sludge in high level waste tanks. This process was demonstrated full scale in Tank 51 at SRS. It reduced the aluminum by 65% which reduced the canister count by 100, thereby reducing the cost by approximately $40 million.

- Enhanced Attenuation is an alternative approach to pump and treat. A full-scale test at SRS T-area was conducted. An edible oil was injected into the subsurface to reduce chlorinated solvents concentrations. This is a self—sustaining mechanism requiring no additional human action and can stabilize and shrink the contaminant plume. This process will reduce life-cycle costs associated with pump and treat.

- Innovative approach reduced mercury in East Fork Poplar Creek (EFPC) at Oak Ridge Reservation. Preliminary results show that diverting 50% or more of the flow augmentation input away from contaminated sediments has the potential to eliminate up to 20% of the mercury input to EFPC at essentially no cost. This results in a decrease in the mercury levels from approximately 8 grams/day to approximately 5 grams/day.

- Matured Wet Air Oxidation (WAO) as an alternative to steam reforming for Tank 48H Project Recovery provided leverage to SR in contract negotiations.

Energy, Environment & the Economy

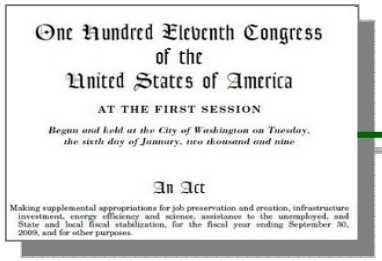
"So we have a choice to make. We can remain one of the world's leading importers of foreign oil, or we can make the investments that would allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stop it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for lasting prosperity."

- President Obama, March 19, 2009

Energy, Environment & the Economy

- Investing in the Clean Energy Jobs of the Future
  - Creating new Jobs in the Clean Energy Economy
  - Investing in the Next Generation of Energy Technologies
- Securing our Energy Future
  - Breaking Dependence on Oil
  - Producing More Energy at Home
  - Promoting Energy Efficiency
- Closing the Carbon Loophole and Cracking Down on Polluters
  - Closing the Carbon Loophole
  - Protecting American Consumers
  - Promoting U.S. Competitiveness
- American Recovery & Reinvestment Act
  - More than $60 billion in clean energy investments to jump-start our economy and build the clean energy jobs of tomorrow.

Footprint Reduction


One Hundred Eleventh Congress
of the
United States of America
AT THE FIRST SESSION
Begun and held at the City of Washington on Tuesday, the sixth day of January, two thousand and nine
An Act
Making supplemental appropriations for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and State and local fiscal stabilization, for the fiscal year ending September 30, 2009, and for other purposes.

Recovery Act

Economic Stimulus

Office of Environmental Management (EM)

EM Footprint Reduction, small site completions, and other investment opportunities

Jobs created

Lifecycle cost reduced

Environment protected

Footprint reduced

Clean, Diverse Energy Sources

- **Energy security**
- **Establish long-term site mission**
- **Sustainable jobs**

Energy Parks

Large tracts of land and infrastructure available

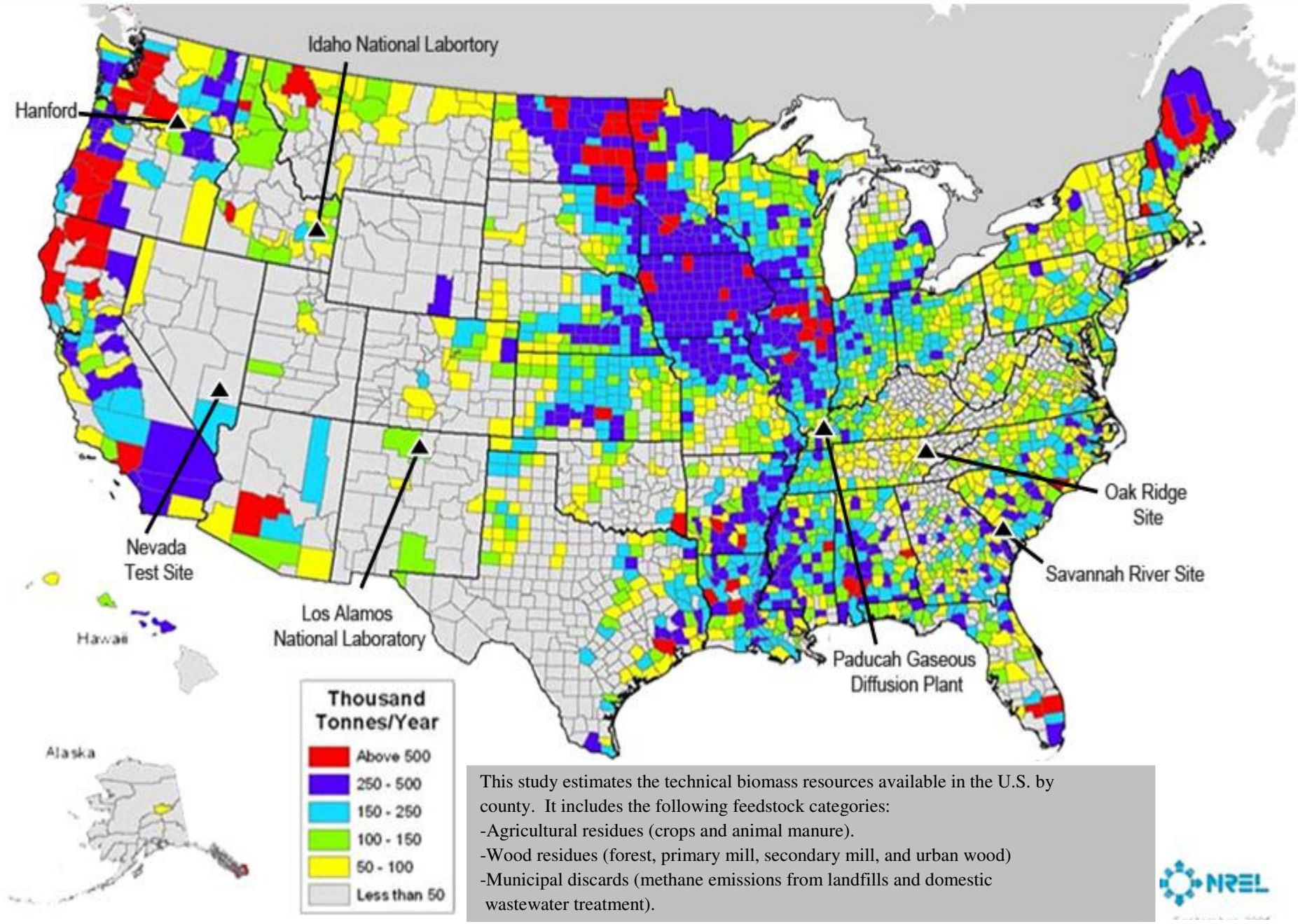
U.S. Department of Energy Secretary Steven Chu

Published: July 22, 2009

Cleaning Up: Energy and Climate Bill Will Boost the Economy

- The status quo on energy is unsustainable. Today, we import about 60 percent of the oil we use, which is a huge drain on our economy and which weakens our security. When we burn fossil fuels for energy, we emit enormous amounts of greenhouse gases, which have already begun to change our climate. Climate experts predict that, on our current course, the planet could be around 10 degrees Fahrenheit warmer by the end of this century. Such an increase could cause more frequent extreme weather events like droughts, heat waves, and hurricanes; rising sea levels and coastal erosion; serious agricultural losses and water shortages; and many other impacts in the United States.
- There is no question that our energy habits need to change. The only question is whether we can turn this energy challenge into an energy opportunity.
- Here is the future that I see. In the coming decades, the laws of supply and demand will almost certainly force oil and gas prices to rise. At the same time, the consequences of climate change will become so starkly apparent that continuing to emit carbon pollution at today's levels will be unacceptable. As a result, clean-energy technologies will be in high demand. Tens of thousands of windmills and solar panels will be manufactured and installed around the world. Consumers will demand more efficient vehicles, appliances, and buildings. There will be a race to produce the most advanced batteries and biofuels.
- We must ask ourselves: How does the United States want to position itself in this future world? When the great hockey player Wayne Gretzky was asked how he positions himself on the ice, he replied: "I skate to where the puck is going to be, not where it's been." America should do the same.

Biomass Resources



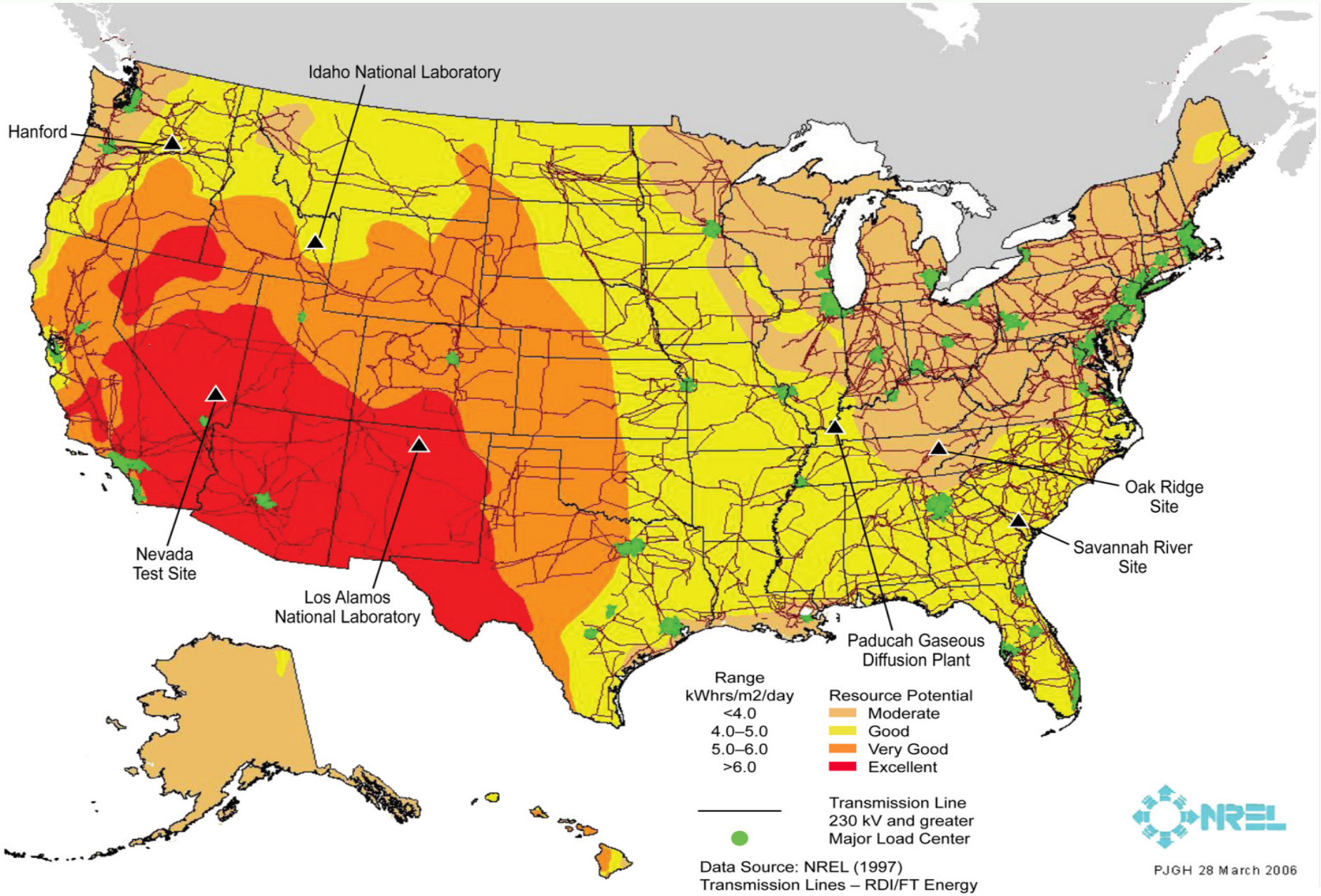
This study estimates the technical biomass resources available in the U.S. by county. It includes the following feedstock categories:

-Agricultural residues (crops and animal manure).

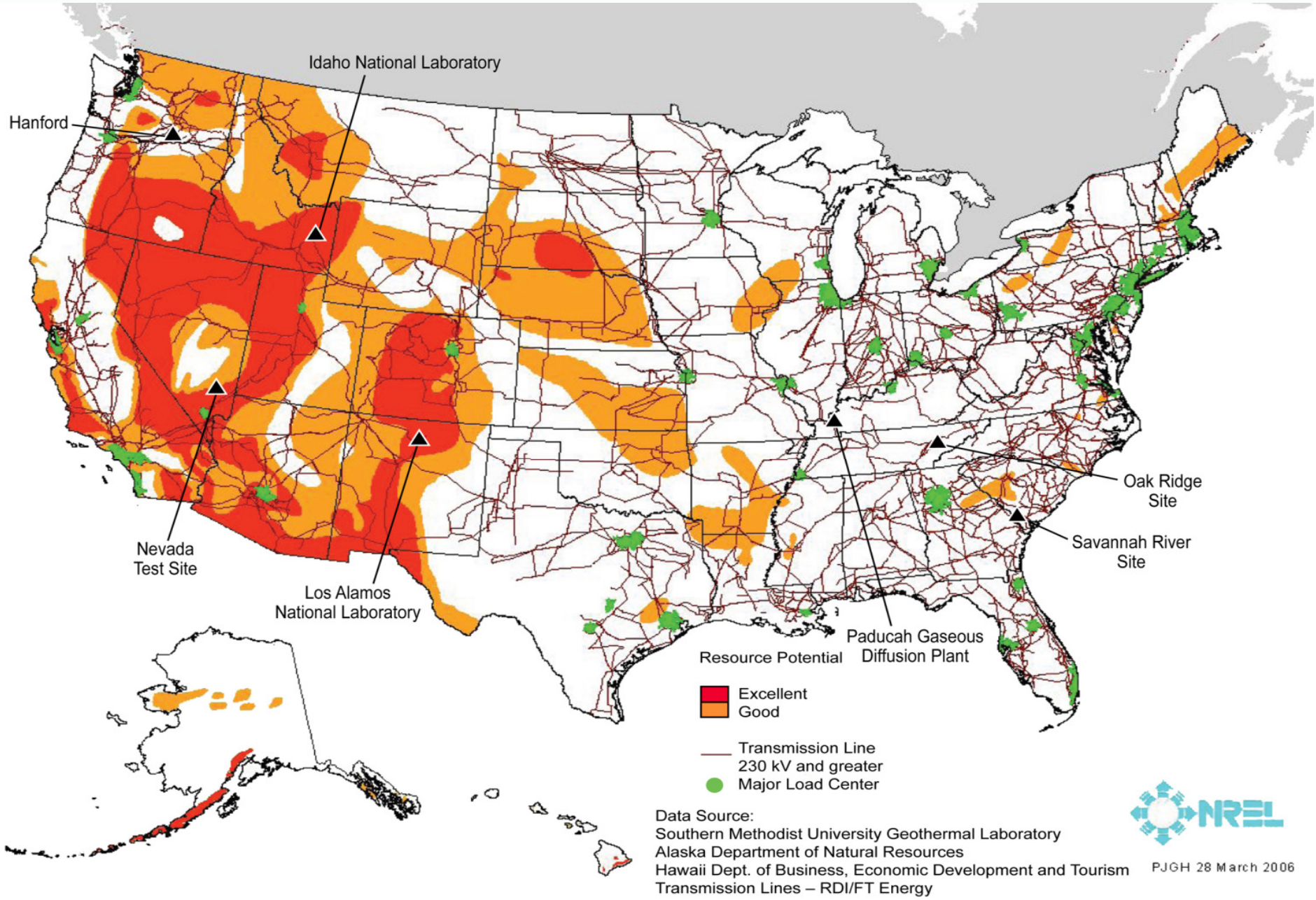
-Wood residues (forest, primary mill, secondary mill, and urban wood)

-Municipal discards (methane emissions from landfills and domestic wastewater treatment).

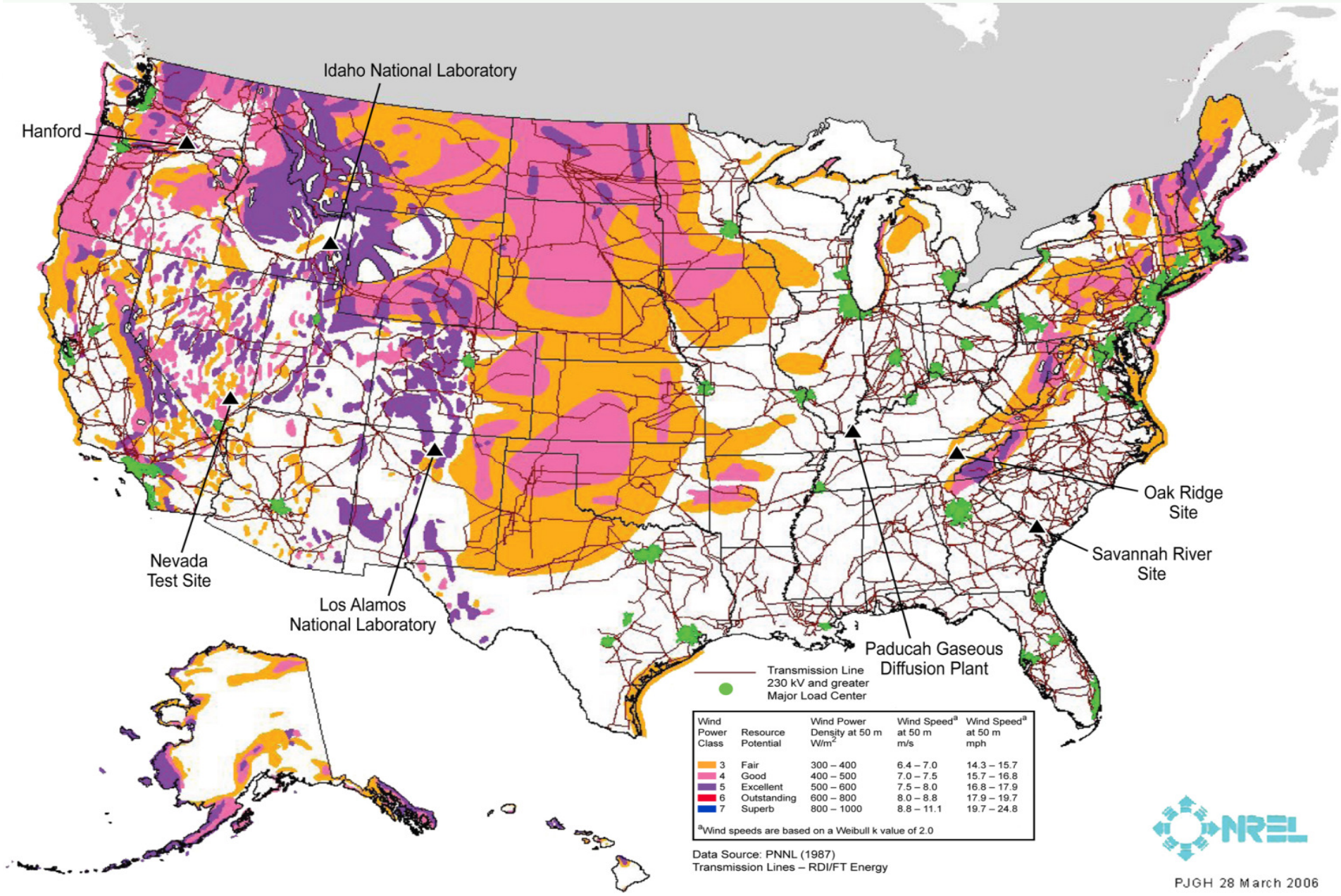
Solar Resources



Geothermal Resources

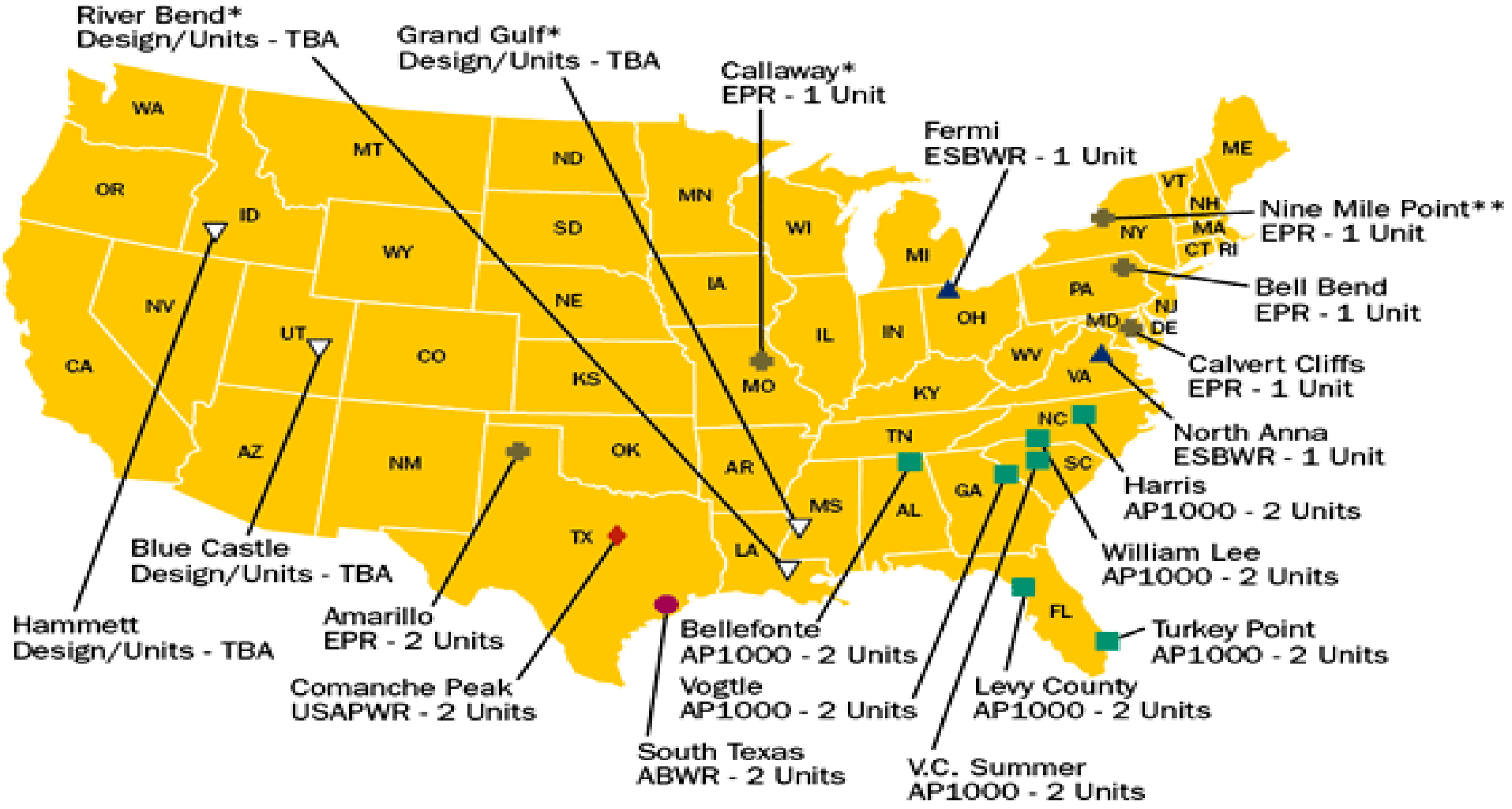


Wind Resources



PJGH 28 March 2006

Location of Projected New Nuclear Power Reactors



You may click on a design name to view the NRC's Web site for the specific design.

● ABWR ■ AP1000 ✚ EPR ▲ ESBWR ◆ USAPWR ▽ Design/Units - TBA

*Review Suspended

**Review Partially Suspended